

Sansevieria aethiopica Thunb.: A review of its botany, medicinal uses and biological activities

A Maroyi

Medicinal Plants and Economic Development (MPED) Research Centre, Department of Botany, University of Fort Hare, Private Bag X1314, Alice 5700, South Africa; E-mail: amaroyi@ufh.ac.za

Abstract

Sansevieria aethiopica is a perennial herb widely used as herbal medicine in southern Africa. This study is aimed at providing a critical review of the botany, medicinal uses and biological activities of *S. aethiopica*. Documented information on the botany, medicinal uses and biological activities of *S. aethiopica* was collected from several online sources which included BMC, Scopus, SciFinder, Google Scholar, Science Direct, Elsevier, Pubmed and Web of Science. Additional information on the botany, medicinal uses and biological activities, of *S. aethiopica* was gathered from pre-electronic sources such as book chapters, books, journal articles and scientific publications sourced from the University library. This study showed that the leaf sap, leaves, rhizomes and roots of *S. aethiopica* are used as herbal medicines for diarrhoea, earache and ear infections, haemorrhoids, intestinal parasites and worms, sores and wounds, stomach problems, toothache and ulcers. Pharmacological research revealed that *S. aethiopica* crude extracts have antibacterial, antifungal, antioxidant, antiprotozoan and cytotoxicity activities. *Sansevieria aethiopica* should be subjected to detailed phytochemical, pharmacological and toxicological evaluations aimed at correlating its medicinal uses with its phytochemistry and pharmacological activities of the species.

Keywords: Asparagaceae, ethnopharmacology, herbal medicine, indigenous pharmacopeia, *Sansevieria aethiopica*

INTRODUCTION

Sansevieria aethiopica Thunb. is a member of the Asparagaceae family,¹ a classification system that is in agreement with the Angiosperm Phylogeny Group.² *Sansevieria aethiopica* has also been placed within Agavaceae, Convallariaceae, Dracaenaceae, Liliaceae and Ruscaceae families.³⁻¹² According to Plants of the World Online,¹³ *S. aethiopica* is a synonym of *Dracaena aethiopica* (Thunb.) Byng & Christenh. However, according to The Plant List, created and managed by the Royal Botanic Gardens (UK) and the Missouri Botanical Gardens (USA), *S. aethiopica* is a valid and accepted name.¹⁴ Therefore, in this study, the name *S. aethiopica* and family Asparagaceae have been adopted and will be used throughout the manuscript. The roots of *S. aethiopica* are sold as herbal medicines in KwaZulu-Natal province in South Africa.^{15,16} *Sansevieria aethiopica* is also one of the important medicinal plants in South Africa, included in the book "medicinal plants of South Africa", a photographic guide to the most commonly used plant medicines in the country, including their botany, main traditional uses and active ingredients.¹⁷ Rhizomes of *S. aethiopica* are a source of drinking water in the Kalahari desert in Namibia.¹⁸⁻²⁰ Leaves of *S. aethiopica* are an important ingredient of bushmen arrow poison, and the species is usually mixed species such as *Acacia mellifera* (M. Vahl) Benth., *Asparagus exuvialis* Burch., *Bobgunnia madagascariensis* (Desv.) J.H. Kirkbr. & Wiersema, *Dicerocaryum eriocarpum* (Decne.) Abels, *Ipomoea bolusiana* Schinz, *Jatropha erythropoda* Pax & K. Hoffm., *Lonchocarpus nelsii* (Schinz) Heering & Grimme, *Raphionacme velutina* Schltr., *R. lanceolata* Schinz, *Solanum kwebense* N.E. Br., *Tarchonanthus camphoratus* L., *Terminalia sericea* Burch. ex DC. and larvae of *Diamphidia* beetle.^{18,21-26} It is within this context that this review was undertaken aimed at reviewing the botany, medicinal uses and biological activities of *S. aethiopica* so

as to provide baseline data required in evaluating the therapeutic potential of the species.

Botanical profile of *Sansevieria aethiopica*

The genus *Sansevieria* Thunb. is in honour of an Italian Pietro Antonio Sanseverino, Count of Chiaromonte (1724-1771) in whose garden the plant was growing.¹⁹ The specific name "aethiopica" is indirectly related to Ethiopia as in classical times the name was used in reference to "south of the known world", that is, south of Libya and Egypt, now known as southern Africa.²⁷ The name *S. aethiopica* is associated with the following synonyms: *S. caespitosa* Dinter, *S. glauca* Haw., *S. scabrifolia* Dinter, *S. thunbergii* Mattei and *S. zeylanica* sensu Baker.^{6,19,27,28} *Sansevieria aethiopica* has been recorded in Botswana, Mozambique, Namibia, South Africa, Zambia and Zimbabwe.^{6,19,27,28}

Sansevieria aethiopica is a succulent, evergreen, perennial herb which can grow up to 75 cm high growing from a thick rhizomatous rooting system, often forming large colonies.^{6,27,28} The leaves are erect or somewhat recurved, loosely clustered, smooth margined, white in colour with inner red line, thick and leathery with a rough surface, green in colour, mottled with paler bands, apex whitish and spiny. The inflorescence is a dense spike-like, with white, cream or greenish, sometimes tinged purple flowers. The fruits are spherical in shape, lobed and red when ripe. *Sansevieria aethiopica* is widespread in deep shade in well-drained areas of mixed woodland, savanna, preferring termite mounds, sandy soil, rocky places at an altitude ranging from 100 m to 1465 m above sea level.^{6,19,27,28}

Medicinal uses of *Sansevieria aethiopica*

The leaf sap, leaves, rhizomes and roots of *S. aethiopica* are used as herbal medicines for diarrhoea, earache and ear infections, haemorrhoids, intestinal parasites and worms,

sores and wounds, stomach problems, toothache and ulcers (Table 1; Figure 1). Other minor medicinal applications recorded in a single country include use of the species as aphrodisiac,²⁹ to increase appetite in children,³⁰ magical

purposes,³¹ scare-off snakes,²⁹ stimulate milk production^{20,32,33} and as herbal medicine for abdominal pains,¹⁸ stiff neck^{18,20,32,33} and venereal diseases.^{31,34}

Table 1: Medicinal uses of *Sansevieria aethiopica*

Medicinal use	Parts used	Country	References
Abdominal pains	Roots	South Africa	Neuwinger ¹⁸
Aphrodisiac	Leaves	Zimbabwe	Takawira-Nyenya and Stedje ²⁹
Diarrhoea	Roots and rhizomes	South Africa and Zimbabwe	Van Wyk et al. ¹⁷ ; Neuwinger ¹⁸ ; Takawira-Nyenya ²⁰ ; Buyun et al. ³² ; Tkachenko et al. ³³ ; Van Wyk and Gericke ³⁵
Earache and ear infections	Leaves and rhizomes	Botswana, South Africa and Zimbabwe	Van Wyk et al. ¹⁷ ; Heath and Heath ¹⁹ ; Takawira-Nyenya ²⁰ ; Takawira-Nyenya and Stedje ²⁹ ; Hedberg and Staugard ³⁰ ; Hutchings et al. ³¹ ; Buyun et al. ³² ; Tkachenko et al. ³³ ; Van Wyk and Gericke ³⁵ ; Case ³⁶ ; Van Wyk et al. ³⁷ ; Maroyi ³⁸ ; David et al. ³⁹
Haemorrhoids	Roots and rhizomes	South Africa and Zimbabwe	Van Wyk et al. ¹⁷ ; Neuwinger ¹⁸ ; Takawira-Nyenya ²⁰ ; Buyun et al. ³² ; Tkachenko et al. ³³ ; Van Wyk and Gericke ³⁵ ; Case ³⁶ ; Van Wyk ⁴⁰
Increase appetite in children	Leaves	Botswana	Hedberg and Staugard ³⁰
Intestinal parasites and worms	Leaves and rhizomes	South Africa and Zimbabwe	Van Wyk et al. ¹⁷ ; Takawira-Nyenya ²⁰ ; Buyun et al. ³² ; Tkachenko et al. ³³ ; Van Wyk and Gericke ³⁵ ; Case ³⁶ ; Van Wyk ⁴⁰ ; Cork et al. ⁴¹
Magical purposes	Rhizomes	South Africa	Hutchings et al. ³¹
Scare-off snakes	Leaves	Zimbabwe	Takawira-Nyenya and Stedje ²⁹
Stiff neck	Leaves	Namibia	Neuwinger ¹⁸ ; Takawira-Nyenya ²⁰ ; Buyun et al. ³² ; Tkachenko et al. ³³
Stimulate milk production	Leaf sap	Namibia	Takawira-Nyenya ²⁰ ; Buyun et al. ³² ; Tkachenko et al. ³³
Stomach problems	Rhizome	South Africa and Zimbabwe	Van Wyk et al. ¹⁷ ; Takawira-Nyenya ²⁰ ; Buyun et al. ³² ; Tkachenko et al. ³³ ; Van Wyk and Gericke ³⁵
Toothache	Leaves and rhizomes	South Africa and Zimbabwe	Van Wyk et al. ¹⁷ ; Takawira-Nyenya ²⁰ ; Takawira-Nyenya and Stedje ²⁹ ; Buyun et al. ³² ; Tkachenko et al. ³³ ; Van Wyk and Gericke ³⁵ ; Case ³⁶
Ulcers	Rhizome	South Africa and Zimbabwe	Van Wyk et al. ¹⁷ ; Takawira-Nyenya ²⁰ ; Buyun et al. ³² ; Tkachenko et al. ³³ ; Van Wyk and Gericke ³⁵ ; Case ³⁶
Venereal diseases	Leaves	South Africa	Hutchings et al. ³¹ ; Van Vuuren and Naidoo ³⁴
Sores and wounds	Leaf sap and leaves	Botswana and Namibia	Takawira-Nyenya ²⁰ ; Hedberg and Staugard ³⁰ ; Buyun et al. ³² ; Tkachenko et al. ³³

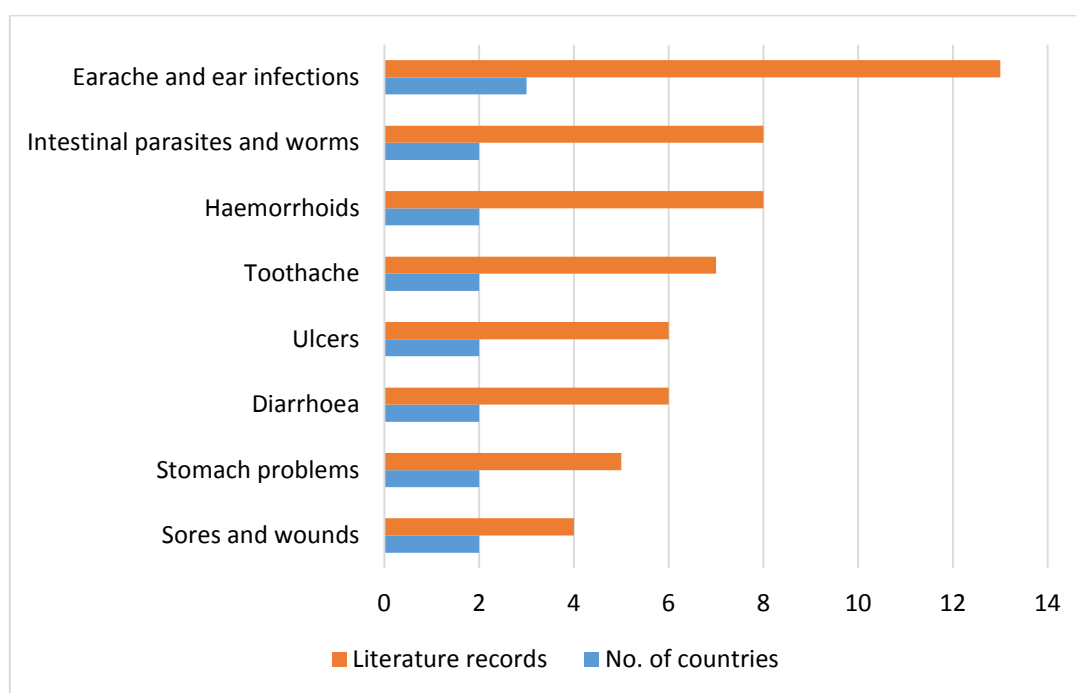


Figure 1. Medicinal uses of *Sansevieria aethiopica*

Biological activities of *Sansevieria aethiopica*

David and Afolayan⁴² found the amount of phenolics and flavonoids in the leaf extracts of *S. aethiopica* to be 19.1 to 57.1 mg tannic acid equivalent/gram and 5.9 to 7.2 mg quercetin equivalent/gram, respectively. The flavonols and proanthocyanidins concentrations in the leaf extracts were 2.8 to 15.2 mg quercetin equivalent/gram and 1.4 to 14.5 mg catechin equivalent/gram, respectively.⁴² Van Wyk et al.¹⁷ argued that the value of *S. aethiopica* in treating haemorrhoids is due to the presence of various sapogenins, particularly ruscogenin. The following biological activities have been reported from the leaf and root extracts of *S. aethiopica*: antibacterial,^{32-34,36,42-44} antifungal,^{34,39,45,46} antioxidant,^{42,44,47,48} antiprotozoan,³⁴ and cytotoxicity^{42,44} activities.

Antibacterial activities

Case³⁶ evaluated antibacterial activities of 50% methanol and aqueous leaf extracts of *S. aethiopica* against *Staphylococcus aureus*, *Pseudomonas aeruginosa* and *Mycobacterium smegmatis* using a disk diffusion assay with ciprofloxacin as a positive control. The 50% methanol extract exhibited weak activities against *Staphylococcus aureus* and *Mycobacterium smegmatis* with zone of inhibition ranging from 1 mm to 4 mm against 9 mm exhibited by the control.³⁶ Van Vuuren and Naidoo³⁴ evaluated antibacterial activities of aqueous and a mixture of methanol and dichloromethane (1:1) leaf extracts of *S. aethiopica* against bacterial pathogens associated with urogenital or sexually transmitted infections which included *Gardnerella vaginalis*, *Neisseria gonorrhoeae*, *Oligella ureolytica* and *Ureaplasma urealyticum* using the micro-dilution technique with ciprofloxacin (0.01 mg/ml) as a positive control. The extracts exhibited activities with minimal inhibitory concentration (MIC) values ranging from 0.9 mg/ml to >16.0 mg/ml which were higher than 0.1 mg/ml exhibited by the control.³⁴ David and Afolayan⁴³ evaluated the synergistic effects of acetone, ethanol and methanolic leaf extracts of *S. aethiopica* with gentamicin against *Enterococcus faecalis* and *Enterococcus faecalis* using checkerboard macrodilution method and anti-biofilm activity was determined by semi-quantitative adherence assay. The extracts in combinations with gentamicin produced good inhibitory activities with MIC values ranging from 0.2 mg/ml to 0.4 mg/ml. The extracts reduced the pre-formed biofilm at varying degrees.⁴³ Buyun et al.³² evaluated antibacterial activities of ethanolic leaf extracts of *S. aethiopica* against *Staphylococcus aureus* using agar disk diffusion assay. The extract exhibited zone of inhibition of 25 mm.³² David and Afolayan⁴² evaluated antibacterial activities of acetone leaf extracts of *S. aethiopica* against *Pseudomonas aeruginosa*, *Klebsiella pneumoniae*, *Enterobacter cloaca*, *Escherichia coli*, *Bacillus cereus*, *Bacillus pumilus* and *Staphylococcus aureus* using macrobroth dilution method. The extract exhibited activities against tested pathogens with MIC and minimum bacterial concentrations (MBC) values ranging from 0.4 mg/ml to 6.3 mg/ml.⁴² David and Afolayan⁴⁴ evaluated antibacterial activities of acetone and methanol

leaf extracts of *S. aethiopica* against *Pseudomonas aeruginosa*, *Klebsiella pneumoniae*, *Enterobacter cloaca*, *Escherichia coli*, *Bacillus cereus*, *Bacillus pumilus* and *Staphylococcus aureus* using macrobroth dilution method. The extracts exhibited activities against tested pathogens with MIC and MBC values ranging from 0.4 mg/ml to 6.3 mg/ml.⁴⁴ Tkachenko et al.³³ evaluated antibacterial activities of ethanolic leaf extracts of *S. aethiopica* against *Escherichia coli* using agar disk diffusion method. The extract exhibited activities with zone of inhibition of 13 mm.³³

Antifungal activities

Van Vuuren and Naidoo³⁴ evaluated antifungal activities of aqueous and a mixture of methanol and dichloromethane (1:1) leaf extracts of *S. aethiopica* against fungal pathogen associated with urogenital or sexually transmitted infections, *Candida albicans* using the micro-dilution technique with amphotericin B (0.1 mg/ml) as a positive control. The aqueous and a mixture of methanol and dichloromethane (1:1) extracts exhibited activities with MIC values of 3.0 mg/ml and 2.0 mg/ml, respectively.³⁴ David and Afolayan⁴⁵ evaluated anti-candidal activities of acetone, ethanol and methanol leaf extracts of *S. aethiopica* against *Candida albicans* using microbroth dilution method with amphotericin B as a positive control. David and Afolayan⁴⁵ also evaluated the structural changes of planktonic and sessile (biofilm) cells after treatment with the extracts using the electron microscope and determined the rate of killing of the test fungus by the extracts using the broth macrodilution technique. The extracts exhibited activities with the MIC, minimum biofilm eradication concentration (MBEC) and minimum biofilm inhibitory concentration (MBIC) values ranging from 1.6 mg/ml to 25.0 mg/ml. Time-kill assays showed that the extracts inhibited the pathogen after 6 hours of exposure. Extract treated cells showed change in the morphology of the cells.⁴⁵ David and Afolayan⁴⁶ evaluated anti-candidal activities of acetone, ethanol and methanol leaf extracts of *S. aethiopica* against *Candida albicans* using microbroth dilution method with amphotericin B as a positive control, and evaluated structural changes in *Candida albicans* after treatment with the extracts using the electron microscope. The extracts exhibited activities with the MIC and minimum fungicidal concentrations (MFC) values ranging from 1.6 mg/ml to 6.3 mg/ml which were higher than MIC and MFC values of 0.008 mg/ml to 0.016 mg/ml exhibited by the control. The extract-treated cells showed alterations in the morphology which included wrinkled surfaces, shrinkages, tears and holes, proton pumping activity was lower in the treated fungi compared to the control and there was a decreased ergosterol content in the treated fungal cells when compared with the control. Therefore, the extracts inhibited growth and interfered with the sterol metabolism in *Candida albicans*.⁴⁶ David et al.³⁹ evaluated antifungal activities of acetone and methanol leaf extracts of *S. aethiopica* against *Absidia corymbifera*, *Aspergillus flavus*, *Aspergillus fumigatus*, *Aspergillus niger*, *Penicillium chalybeum* and *Penicillium expansum* using

the poisoned food technique with amphotericin B as a positive control. The extracts exhibited activities with half maximal inhibitory concentration (IC₅₀) values ranging from 1.0. mg/ml to >10.00 mg/ml. The MIC and MFC ranged from 3.1 mg/ml to >25.00 mg/ml.³⁹

Antioxidant activities

David and Afolayan⁴² evaluated antioxidant activities of acetone leaf extracts of *S. aethiopica* using 2,2-azino-bis-3-ethylbenzothiazoline-6-sulfonic-acid (ABTS), 1,1-diphenyl-2-picrylhydrazyl (DPPH), hydrogen peroxide (H₂O₂) and ferric reducing power (FRAP) assays. The ABTS radical scavenging activity of the extract was 82.0% which was comparable to 90.1% and 83.7% exhibited by the standard drugs butylated hydroxytoluene (BTH) and rutin, respectively. The extracts exhibited good DPPH dose-dependent activities. The acetone extract 0.4 mg/ml showed the highest level of scavenging ability against hydrogen peroxide exhibiting 66.8% which was comparable to 62.8% and 82.1% exhibited by the standard drugs BTH and rutin, respectively. The extract exhibited concentration dependent activities which were comparable to activities exhibited by the standard drugs, Vitamin C, Vitamin E and BHT.⁴² David and Afolayan⁴⁴ evaluated antioxidant activities of acetone and methanol leaf extracts of *S. aethiopica* using ABTS, DPPH, H₂O₂ and FRAP assays. The ABTS radical scavenging activity of the extracts were 76.8% to 83.1% which were comparable to 95.0% and 87.5% exhibited by the standard drugs BTH and rutin, respectively. The extracts exhibited good DPPH dose-dependent activities. The acetone extract 0.8 mg/ml showed the highest level of scavenging ability against H₂O₂ exhibiting 62.9% to 66.8% which were comparable to 62.8% and 82.1% exhibited by the standard drugs BTH and rutin, respectively. The extracts exhibited concentration dependent activities which were comparable to activities exhibited by the standard drugs, Vitamin C, Vitamin E and BHT.⁴⁴ Tkachenko et al.⁴⁷ evaluated the antioxidant activities of leaf extracts of *S. aethiopica* by assessing their *in vitro* effects against protein damage in equine erythrocytes using the carbonyl derivatives content of protein oxidative modification (OMP) assay. The extracts reduced the concentration of ketonic derivatives of OMP when compared to untreated erythrocytes by 12.7%.⁴⁷ Similarly, Tkachenko et al.⁴⁸ evaluated the antioxidant activities of leaf extracts of *S. aethiopica* by assessing the level of 2-thiobarbituric acid reactive substances (TBARS) as biomarkers of lipid peroxidation in equine erythrocyte suspension induced by treatment of the leaf extracts. The leaf extracts resulted in a significant increase of 36.6% of TBARS concentration in erythrocytes. These results suggest that *S. aethiopica* has a promising antioxidant and prooxidant potential.

Antiprotozoan activities

Van Vuuren and Naidoo³⁴ evaluated antiprotozoan activities of aqueous and a mixture of methanol and dichloromethane (1:1) leaf extracts of *S. aethiopica* against protozoan pathogen associated with urogenital or sexually transmitted infections, *Trichomonas vaginalis*

using the micro-dilution technique with ciprofloxacin (0.01 mg/ml) as a positive control. The aqueous and a mixture of methanol and dichloromethane (1:1) leaf extracts exhibited activities with MIC values of 1.3 mg/ml and 4.0 mg/ml which were higher than 0.1 mg/ml exhibited by the control.³⁴

Cytotoxicity activities

David and Afolayan⁴² evaluated cytotoxicity activities of acetone leaf extracts of *S. aethiopica* using the larvae of brine shrimp nauplii, *Artemia salina* L. The extract had lethal effects on the brine shrimp nauplii with the median lethal dose (LD₅₀) value of 3.2 ppm.⁴² Similarly, David and Afolayan⁴⁴ evaluated cytotoxicity activities of acetone and methanol leaf extracts of *S. aethiopica* using the larvae of brine shrimp nauplii, *Artemia salina* L. The acetone and methanol extracts had lethal effects on the brine shrimp nauplii with LD₅₀ values of 3.2 ppm and 3.7 ppm, respectively which were comparable to the median lethal concentration (LC₅₀) value of 1 ppm of the standard drug.⁴⁹

CONCLUSION

The present review summarizes the botany, ethnomedicinal uses and biological activities of the leaf sap, leaves, rhizomes and roots of *S. aethiopica*. From a chemical, pharmacological and toxicological point of view, *S. aethiopica* has not received any major emphasis. Currently, there is not yet enough data on ethnopharmacological evaluations on the species that can be correlated with its medicinal applications. Therefore, detailed phytochemical, pharmacological and toxicological studies of *S. aethiopica* are recommended.

Conflict of interest

The author declares that he has no conflict of interest.

Acknowledgements

I would like to express my gratitude to the National Research Foundation (NRF), South Africa and Govan Mbeki Research and Development Centre (GMRDC), University of Fort Hare for financial support to conduct this study.

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